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(56) Documents Cited

**GB 2158471 A EP 0572965 A1 EP 0402165 A1**  
**WO 91/08895 A2 US 4820568 A US 4813535 A**  
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(54) Protective material

(57) A protective material has at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or knife, and a support material. The fibres are at least partially embedded within the support material to restrict relative movement of the fibres therein. The fibres may be of polyethylene, glass, carbon or preferably aromatic polyamide. The support material is preferably a thermosetting resin such as an epoxy-, phenolic-, or polyester-based resin.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

GB 2 304 350 A

## PROTECTIVE MATERIAL

This invention relates to a protective material.

It is known to use personal body armour to give protection against a wide variety of threats. This armour typically comprises a pack containing layers of woven aramid fibre.

In order to provide the capability to resist multiple hits from projectiles it is usual to stitch or quilt the layers together; this helps to prevent "bunching", which causes the layers to bunch up together, and progressively reduces the protection after each hit.

It is also known to provide additional material to reduce the trauma effect caused to the wearer by the impact of the projectile. The additional material may comprise, for example, one or more layers of plastic or rubber foam; one or more polyolefin sheets; or one or more packs of feathers.

When protection from knife impact is also required it is usual to add a still further layer, which comprises, for example, metal meshes; lightweight metal panels; or overlapping medallions of lightweight metal.

It will be appreciated that each protective layer adds to the thickness and weight of the armour, thereby reducing its wearability.

According to one aspect of the present invention there is provided a protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet, and a support material, said fibres being at least partially embedded within the support material to restrict relative movement of the fibres therein.

Advantageously the support material is a resin, more preferably

a synthetic resin, and most preferably a thermosetting resin. The precise resin used depends upon the final application of the material: an epoxy-based resin, a phenolic-based resin or a polyester-based resin is preferred. It is also preferred that the support material has sufficient rigidity to enable the or each flexible layer to support its own weight.

The fibres are typically of the type that have a high tensile strength and a high stretch resistance. The fibres may comprise high strength polyethylene fibres, glass fibres, or carbon<sup>(K.T.N.)</sup> fibres. In the preferred embodiment the fibres comprise aramid<sub>4</sub> fibres, particularly fibres of poly(p-phenylene terephthalamide). When aramid fibres are used, they may, for example, comprise the fibres sold under the trade names KEVLAR<sup>(K.T.N.)</sup> or TWARON<sup>(K.T.N.)</sup>.

In one embodiment, the fibres are woven to form a fabric, prior to being embedded in the support. In another embodiment, the fibres are arranged in a unidirectional manner, ie, they are not woven.

Preferably the protective material contains 20-50 wt% of the support material, most preferably 33 wt%.

It is referred that the fibres are substantially entirely embedded in the support material, because this provides the best resistance to penetration by a knife or similar object.

There are a number of parameters of the protective material which depend upon the use to which it will be put, and also on the type of fibres and support material used. These parameters include the number of flexible layers, the thickness of each flexible layer, and the denier of the fibres. Typically, there will be between 5 and 50 layers, each having a thickness between 0.2mm and 0.5mm, with the fibres having a denier between 400 and 1500.

The most preferred fibres are available from Du Pont under the registered trade name KEVLAR 129 (or KEVLAR HT). Using these

fibres, together with a resin comprising a blend of bisphenol A and bisphenol F, the denier of the fibres is most preferably 840, the thickness of each layer is preferably 0.25mm and the number of layers is preferably 26. This will provide a level of protection that can prevent penetration by hand gun bullets, and can provide adequate protection against trauma; it will also provide protection against a knife strike having an energy of 42 Joules, or more. The material is capable of meeting applicable standards set by the British Home Office.

In order to provide sufficient protection against high velocity bullets the protective material may include at least one layer of ceramic plates, such as alumina plates. It will be appreciated that other materials, known to those skilled in the art, may be used to provide protection against high velocity bullets.

The protective material according to the invention is particularly useful as personal body armour. For example, it can be provided in the form of, or as part of, a vest or jacket for providing body protection to the front and/or the back; it may be provided in the form of, or as part of, any other garment to protect any other part of the body, for example the arms or the legs. The protective material may be provided in the form of, or as part of, headwear, such as a helmet; or it may be provided in the form of, or as part of, footwear, such as boots. The protective material may be provided in the form of, or as part of, a hand-held shield.

The protective material may be provided in the form of a pack that can be removably secured to a garment. It may be incorporated into an existing protective garment by mixing with or adding to protective layers already in the garment - this will enhance the performance of the protective layers already present.

The protective material according to the invention may instead be used as armour for vehicles, ships, aeroplanes or buildings.

It is possible to protect against a wide variety of ballistic threats with the protective material according to the invention. The material can also provide adequate protection against trauma, without the need to use any additional layer of a different material. The material is also capable of preventing penetration by a knife or other sharp instrument.

The material is resistant to the problem of bunching, discussed above, due to the ability of each layer to support its own weight, so it is not necessary to stitch or quilt together multiple flexible layers.

According to another aspect of the invention there is provided a composite material comprising aramid fibres treated with a resin.

Advantageously the aramid fibres are poly(p-phenylene terephthalamide). The resin is preferably a synthetic resin, and is most preferably a thermosetting resin: epoxy-based resins and phenolic-based resins are particularly preferred.

The resin can provide a matrix, into which the fibres are embedded, in order to resist relative movement of the fibres within the resin; the resin may be impregnated into the fibres.

The composite material is preferably flexible, but sufficiently stiff to support its own weight.

The composite material is particularly useful when provided in sheet form, when it may be used as a protective material as described above.

In one embodiment, the protective material can be made by pre-impregnating the fibres with a resin, then subsequently curing the resin by heat and pressure (typically from 100 to 150 degrees C and 50 to 150 psi [345 to 1035 KPa]). The pre-impregnated fibres may be stored and/or transported, preferably in roll form,

before they are finally cured.

In another embodiment, the protective material may be made by impregnating the fibres with a resin, followed by curing shortly thereafter. In this embodiment a low viscosity epoxy resin is preferred, such as a resin manufactured from epichlorohydrin with a blend of bisphenol A and bisphenol F (this is available from ASTOR STAG as product type 629), and a suitable curing agent. The curing agent may be a polyalkylamine; one example of a suitable curing agent is available from ASTOR STAG as product type RS 4025. An entire roll, or part of a roll, of the fibres may be dipped in the resin to coat either the entire roll or part of the roll. The resin can be cured at ambient temperature under a pressure of 10 to 20 psi (69 to 138 KPa).

In both embodiments, the impregnated material can be cut into sheets either before or after curing. When the material is cut into sheets before curing, then between 5 and 50 sheets may be placed on top of one another with a release film <sup>(K.T.D.)</sup> between each layer. The release film may be, for example, mylar, a polyolefin film, or a silicone-coated paper. The multiple sheets can then be cured; after curing the sheets are separated, and the release film is either discarded or re-used.

One or more of the layers may then be used to form the protective material described above. The material may then be used on its own, or may be added to standard ballistic fabrics in order to improve the performance thereof.

The impregnated material can be shaped before it is cured, for example in a mould. If desired, the impregnated material can be cured in the mould. One reason to shape the material is to provide a shape suitable to be worn by a woman.

Whilst certain embodiments of the invention have been described above it will be appreciated that modifications, not described above, could be made to the invention.

CLAIMS:

1. A protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or a knife, and a support material, at least part of said fibres being embedded within the support material to restrict relative movement of the fibres therein.
2. A protective material according to claim 1, wherein the support material is a resin.
3. A protective material according to claim 1, wherein the support material is a synthetic resin.
4. A protective material according to claim 1, wherein the support material comprises a thermosetting resin.
5. A protective material according to any preceding claim, wherein the support material is an epoxy-based resin, a phenolic-based resin or a polyester-based resin.
6. A protective material according to any preceding claim, wherein the fibres comprise polyethylene fibres, glass fibres, carbon fibres or aramid fibres.
7. A protective material according to claim 6, wherein the fibres comprise fibres of poly(p-phenylene terephthalamide).
8. A protective material according to any preceding claim, wherein the support material comprises 20-50 wt % of the protective material.
9. A protective material according to any preceding claim comprising

between 5 and 50 of said flexible layers.

10. A protective material according to any preceding claim, wherein the or each flexible layer has a thickness between 0.2mm and 0.5mm.

11. A protective material according to any preceding claim, wherein said fibres have a denier between 400 and 1500.

12. A protective material according to any preceding claim, further including at least one layer containing ceramic plates.

13. A garment made at least partly from a protective material according to any preceding claim.

14. A garment according to claim 13, comprising a vest or jacket.

15. A garment according to claim 13 or 14, wherein the protective material is provided in the form of a pack that can be removably secured to the garment.

16. Headwear made at least partly from a protective material according to any one of claims 1 to 12.

17. Footwear made at least partly from a protective material according to any one of claims 1 to 12.

18. A composite material comprising aramid fibres treated with a resin.

19. A composite material according to claim 18, wherein the aramid



fibres are poly(p-phenylene terephthalamide).

20. A composite material according to claim 18 or 19, wherein the resin is a thermosetting resin.
21. A composite material according to claim 18, 19 or 20, wherein the resin is an epoxy based resin, a phenolic-based resin or polyester-based resin.
22. The use of a composite material according to any one of claims 18 to 21 in a protective material to provide resistance to penetration by a bullet or knife.
23. The use according to claim 22, to provide trauma protection as well as said penetration resistance.
24. A protective material substantially as herein described.
25. A composite material substantially as herein described.

**Amendments to the claims have been filed as follows**

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CLAIMS:

1. A protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or a knife, and a support material, at least part of said fibres being embedded within the support material to restrict relative movement of the fibres therein.
2. A protective material according to claim 1, wherein the support material is a resin.
3. A protective material according to claim 1, wherein the support material is a synthetic resin.
4. A protective material according to claim 1, wherein the support material comprises a thermosetting resin.
5. A protective material according to any preceding claim, wherein the support material is an epoxy-based resin, a phenolic-based resin or a polyester-based resin.
6. A protective material according to any preceding claim, wherein the fibres comprise polyethylene fibres, glass fibres, carbon fibres or aramid fibres.
7. A protective material according to claim 6, wherein the fibres comprise fibres of poly(p-phenylene terephthalamide).
8. A protective material according to any preceding claim, wherein the support material comprises 20-50 wt % of the protective material.
9. A protective material according to any preceding claim comprising

between 5 and 50 of said flexible layers.

10. A protective material according to any preceding claim, wherein the or each flexible layer has a thickness between 0.2mm and 0.5mm.

11. A protective material according to any preceding claim, wherein said fibres have a denier between 400 and 1500.

12. A protective material according to any preceding claim, further including at least one layer containing ceramic plates.

13. A protective material according to any preceding claim, wherein the support material has sufficient rigidity to enable the or each flexible layer to support its own weight.

14. A protective material according to any preceding claim, comprising multiple flexible layers.

15. A protective material according to claim 14, wherein the flexible layers are separate flexible layers that are not integral with one another.

16. A garment made at least partly from a protective material according to any preceding claim.

17. A garment according to claim 16, comprising a vest or jacket.

18. A garment according to claim 16 or 17, wherein the protective material is provided in the form of a pack that can be removably secured to the garment.

19. Headwear made at least partly from a protective material according to any one of claims 1 to 15.
20. Footwear made at least partly from a protective material according to any one of claims 1 to 15.
21. A composite material comprising aramid fibres treated with a resin.
22. A composite material according to claim 21, wherein the aramid fibres are poly(p-phenylene terephthalamide).
23. A composite material according to claim 21 or 22, wherein the resin is a thermosetting resin.
24. A composite material according to claim 21, 22 or 23, wherein the resin is an epoxy based resin, a phenolic-based resin or polyester-based resin.
25. The use of a composite material according to any one of claims 21 to 24 in a protective material to provide resistance to penetration by a bullet or knife.
26. The use according to claim 25, to provide trauma protection as well as said penetration resistance.
27. A protective material substantially as herein described.
28. A composite material substantially as herein described.



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Claims searched: 1-17,22,23

Examiner: Alexander Littlejohn  
Date of search: 15 October 1996

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): A3V; D1R (RABB, RABD, RABX, RBX, RFA)

Int CI (Ed.6): A41D 13/00, 31/00; F41H 1/00, 1/02, 5/04

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB2158471A (Budd) see whole document e.g. claim 1	1-17,22,23
X	EP0572965A1 (Allied-Signal) see whole document, e.g. claim 1	1-17,22,23
X	EP0402165A1 (Tecnocompositi) see whole document, e.g. Example	1-17,22,23
X	US4820568 (Harpell) see whole document, e.g. claim 1	1-17,22,23
X	US4613535 (Harpell) see whole document, e.g. claim 1	1-17,22,23
X	US4200677 (Bottini) see whole document, e.g. claim 1	1-17,22,23
X	WO91/08895A2 (Allied-Signal) see whole document, e.g. claim 1	1-17,22,23

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.  
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A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

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**WO 91/08895 A2** **US 4820568 A** **US 4813535 A**  
**US 4200677 A**

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(54) **Protective material**

(57) A protective material has at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or knife, and a support material. The fibres are at least partially embedded within the support material to restrict relative movement of the fibres therein. The fibres may be of polyethylene, glass, carbon or preferably aromatic polyamide. The support material is preferably a thermosetting resin such as an epoxy-, phenolic-, or polyester-based resin.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

**GB 2 304 350 A**

## PROTECTIVE MATERIAL

This invention relates to a protective material.

It is known to use personal body armour to give protection against a wide variety of threats. This armour typically comprises a pack containing layers of woven aramid fibre.

In order to provide the capability to resist multiple hits from projectiles it is usual to stitch or quilt the layers together; this helps to prevent "bunching", which causes the layers to bunch up together, and progressively reduces the protection after each hit.

It is also known to provide additional material to reduce the trauma effect caused to the wearer by the impact of the projectile. The additional material may comprise, for example, one or more layers of plastic or rubber foam; one or more polyolefin sheets; or one or more packs of feathers.

When protection from knife impact is also required it is usual to add a still further layer, which comprises, for example, metal meshes; lightweight metal panels; or overlapping medallions of lightweight metal.

It will be appreciated that each protective layer adds to the thickness and weight of the armour, thereby reducing its wearability.

According to one aspect of the present invention there is provided a protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet, and a support material, said fibres being at least partially embedded within the support material to restrict relative movement of the fibres therein.

Advantageously the support material is a resin, more preferably



a synthetic resin, and most preferably a thermosetting resin. The precise resin used depends upon the final application of the material: an epoxy-based resin, a phenolic-based resin or a polyester-based resin is preferred. It is also preferred that the support material has sufficient rigidity to enable the or each flexible layer to support its own weight.

The fibres are typically of the type that have a high tensile strength and a high stretch resistance. The fibres may comprise high strength polyethylene fibres, glass fibres, or carbon<sup>(K.T.N.)</sup> fibres. In the preferred embodiment the fibres comprise aramid<sub>1</sub> fibres, particularly fibres of poly(p-phenylene terephthalamide). When aramid fibres are used, they may, for example, comprise the fibres sold under the trade names KEVLAR<sup>(K.T.N.)</sup> or TWARON<sub>1</sub><sup>(K.T.N.)</sup>.

In one embodiment, the fibres are woven to form a fabric, prior to being embedded in the support. In another embodiment, the fibres are arranged in a unidirectional manner, ie, they are not woven.

Preferably the protective material contains 20-50 wt% of the support material, most preferably 33 wt%.

It is referred that the fibres are substantially entirely embedded in the support material, because this provides the best resistance to penetration by a knife or similar object.

There are a number of parameters of the protective material which depend upon the use to which it will be put, and also on the type of fibres and support material used. These parameters include the number of flexible layers, the thickness of each flexible layer, and the denier of the fibres. Typically, there will be between 5 and 50 layers, each having a thickness between 0.2mm and 0.5mm, with the fibres having a denier between 400 and 1500.

The most preferred fibres are available from Du Pont under the registered trade name KEVLAR 129 (or KEVLAR HT). Using these

fibres, together with a resin comprising a blend of bisphenol A and bisphenol F, the denier of the fibres is most preferably 840, the thickness of each layer is preferably 0.25mm and the number of layers is preferably 26. This will provide a level of protection that can prevent penetration by hand gun bullets, and can provide adequate protection against trauma; it will also provide protection against a knife strike having an energy of 42 Joules, or more. The material is capable of meeting applicable standards set by the British Home Office.

In order to provide sufficient protection against high velocity bullets the protective material may include at least one layer of ceramic plates, such as alumina plates. It will be appreciated that other materials, known to those skilled in the art, may be used to provide protection against high velocity bullets.

The protective material according to the invention is particularly useful as personal body armour. For example, it can be provided in the form of, or as part of, a vest or jacket for providing body protection to the front and/or the back; it may be provided in the form of, or as part of, any other garment to protect any other part of the body, for example the arms or the legs. The protective material may be provided in the form of, or as part of, headwear, such as a helmet; or it may be provided in the form of, or as part of, footwear, such as boots. The protective material may be provided in the form of, or as part of, a hand-held shield.

The protective material may be provided in the form of a pack that can be removably secured to a garment. It may be incorporated into an existing protective garment by mixing with or adding to protective layers already in the garment - this will enhance the performance of the protective layers already present.

The protective material according to the invention may instead be used as armour for vehicles, ships, aeroplanes or buildings.

It is possible to protect against a wide variety of ballistic threats with the protective material according to the invention. The material can also provide adequate protection against trauma, without the need to use any additional layer of a different material. The material is also capable of preventing penetration by a knife or other sharp instrument.

The material is resistant to the problem of bunching, discussed above, due to the ability of each layer to support its own weight, so it is not necessary to stitch or quilt together multiple flexible layers.

According to another aspect of the invention there is provided a composite material comprising aramid fibres treated with a resin.

Advantageously the aramid fibres are poly(p-phenylene terephthalamide). The resin is preferably a synthetic resin, and is most preferably a thermosetting resin: epoxy-based resins and phenolic-based resins are particularly preferred.

The resin can provide a matrix, into which the fibres are embedded, in order to resist relative movement of the fibres within the resin; the resin may be impregnated into the fibres.

The composite material is preferably flexible, but sufficiently stiff to support its own weight.

The composite material is particularly useful when provided in sheet form, when it may be used as a protective material as described above.

In one embodiment, the protective material can be made by pre-impregnating the fibres with a resin, then subsequently curing the resin by heat and pressure (typically from 100 to 150 degrees C and 50 to 150 psi [345 to 1035 KPa]). The pre-impregnated fibres may be stored and/or transported, preferably in roll form,

before they are finally cured.

In another embodiment, the protective material may be made by impregnating the fibres with a resin, followed by curing shortly thereafter. In this embodiment a low viscosity epoxy resin is preferred, such as a resin manufactured from epichlorohydrin with a blend of bisphenol A and bisphenol F (this is available from ASTOR STAG as product type 629), and a suitable curing agent. The curing agent may be a polyalkylamine; one example of a suitable curing agent is available from ASTOR STAG as product type RS 4025. An entire roll, or part of a roll, of the fibres may be dipped in the resin to coat the either the entire roll or part of the roll. The resin can be cured at ambient temperature under a pressure of 10 to 20 psi (69 to 138 KPa).

In both embodiments, the impregnated material can be cut into sheets either before or after curing. When the material is cut into sheets before curing, then between 5 and 50 sheets may be placed on top of one another with a release film between each layer. The release film may be, for example, mylar<sup>(K.I.D.)</sup>, a polyolefin film, or a silicone-coated paper. The multiple sheets can then be cured; after curing the sheets are separated, and the release film is either discarded or re-used.

One or more of the layers may then be used to form the protective material described above. The material may then be used on its own, or may be added to standard ballistic fabrics in order to improve the performance thereof.

The impregnated material can be shaped before it is cured, for example in a mould. If desired, the impregnated material can be cured in the mould. One reason to shape the material is to provide a shape suitable to be worn by a woman.

Whilst certain embodiments of the invention have been described above it will be appreciated that modifications, not described above, could be made to the invention.

CLAIMS:

1. A protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or a knife, and a support material, at least part of said fibres being embedded within the support material to restrict relative movement of the fibres therein.
2. A protective material according to claim 1, wherein the support material is a resin.
3. A protective material according to claim 1, wherein the support material is a synthetic resin.
4. A protective material according to claim 1, wherein the support material comprises a thermosetting resin.
5. A protective material according to any preceding claim, wherein the support material is an epoxy-based resin, a phenolic-based resin or a polyester-based resin.
6. A protective material according to any preceding claim, wherein the fibres comprise polyethylene fibres, glass fibres, carbon fibres or aramid fibres.
7. A protective material according to claim 6, wherein the fibres comprise fibres of poly(p-phenylene terephthalamide).
8. A protective material according to any preceding claim, wherein the support material comprises 20-50 wt % of the protective material.
9. A protective material according to any preceding claim comprising

between 5 and 50 of said flexible layers.

10. A protective material according to any preceding claim, wherein the or each flexible layer has a thickness between 0.2mm and 0.5mm.

11. A protective material according to any preceding claim, wherein said fibres have a denier between 400 and 1500.

12. A protective material according to any preceding claim, further including at least one layer containing ceramic plates.

13. A garment made at least partly from a protective material according to any preceding claim.

14. A garment according to claim 13, comprising a vest or jacket.

15. A garment according to claim 13 or 14, wherein the protective material is provided in the form of a pack that can be removably secured to the garment.

16. Headwear made at least partly from a protective material according to any one of claims 1 to 12.

17. Footwear made at least partly from a protective material according to any one of claims 1 to 12.

18. A composite material comprising aramid fibres treated with a resin.

19. A composite material according to claim 18, wherein the aramid

fibres are poly(p-phenylene terephthalamide).

20. A composite material according to claim 18 or 19, wherein the resin is a thermosetting resin.
21. A composite material according to claim 18, 19 or 20, wherein the resin is an epoxy based resin, a phenolic-based resin or polyester-based resin.
22. The use of a composite material according to any one of claims 18 to 21 in a protective material to provide resistance to penetration by a bullet or knife.
23. The use according to claim 22, to provide trauma protection as well as said penetration resistance.
24. A protective material substantially as herein described.
25. A composite material substantially as herein described.

**Amendments to the claims have been filed as follows**

**9**

**CLAIMS:**

1. A protective material having at least one flexible layer comprising a plurality of fibres capable of resisting penetration by a bullet or a knife, and a support material, at least part of said fibres being embedded within the support material to restrict relative movement of the fibres therein.
2. A protective material according to claim 1, wherein the support material is a resin.
3. A protective material according to claim 1, wherein the support material is a synthetic resin.
4. A protective material according to claim 1, wherein the support material comprises a thermosetting resin.
5. A protective material according to any preceding claim, wherein the support material is an epoxy-based resin, a phenolic-based resin or a polyester-based resin.
6. A protective material according to any preceding claim, wherein the fibres comprise polyethylene fibres, glass fibres, carbon fibres or aramid fibres.
7. A protective material according to claim 6, wherein the fibres comprise fibres of poly(p-phenylene terephthalamide).
8. A protective material according to any preceding claim, wherein the support material comprises 20-50 wt % of the protective material.
9. A protective material according to any preceding claim comprising



between 5 and 50 of said flexible layers.

10. A protective material according to any preceding claim, wherein the or each flexible layer has a thickness between 0.2mm and 0.5mm.

11. A protective material according to any preceding claim, wherein said fibres have a denier between 400 and 1500.

12. A protective material according to any preceding claim, further including at least one layer containing ceramic plates.

13. A protective material according to any preceding claim, wherein the support material has sufficient rigidity to enable the or each flexible layer to support its own weight.

14. A protective material according to any preceding claim, comprising multiple flexible layers.

15. A protective material according to claim 14, wherein the flexible layers are separate flexible layers that are not integral with one another.

16. A garment made at least partly from a protective material according to any preceding claim.

17. A garment according to claim 16, comprising a vest or jacket.

18. A garment according to claim 16 or 17, wherein the protective material is provided in the form of a pack that can be removably secured to the garment.

19. Headwear made at least partly from a protective material according to any one of claims 1 to 15.
20. Footwear made at least partly from a protective material according to any one of claims 1 to 15.
21. A composite material comprising aramid fibres treated with a resin.
22. A composite material according to claim 21, wherein the aramid fibres are poly(p-phenylene terephthalamide).
23. A composite material according to claim 21 or 22, wherein the resin is a thermosetting resin.
24. A composite material according to claim 21, 22 or 23, wherein the resin is an epoxy based resin, a phenolic-based resin or polyester-based resin.
25. The use of a composite material according to any one of claims 21 to 24 in a protective material to provide resistance to penetration by a bullet or knife.
26. The use according to claim 25, to provide trauma protection as well as said penetration resistance.
27. A protective material substantially as herein described.
28. A composite material substantially as herein described.



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Claims searched: 1-17,22,23

Examiner: Alexander Littlejohn  
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**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): A3V; D1R (RABB, RABD, RABX, RBX, RFA)

Int CI (Ed.6): A41D 13/00, 31/00; F41H 1/00, 1/02, 5/04

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB2158471A (Budd) see whole document e.g. claim 1	1-17,22,23
X	EP0572965A1 (Allied-Signal) see whole document, e.g. claim 1	1-17,22,23
X	EP0402165A1 (Tecnocompositi) see whole document, e.g. Example	1-17,22,23
X	US4820568 (Harpell) see whole document, e.g. claim 1	1-17,22,23
X	US4613535 (Harpell) see whole document, e.g. claim 1	1-17,22,23
X	US4200677 (Bottini) see whole document, e.g. claim 1	1-17,22,23
X	WO91/08895A2 (Allied-Signal) see whole document, e.g. claim 1	1-17,22,23

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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